

LACROSS: Life Analysis, Capture, and Retention on an Orbiting Saturn Spacecraft, Phase I

Completed Technology Project (2018 - 2019)



Project Introduction

We propose to build and critically test key subsystems of Life Analysis, Capture, and Retention on an Orbiting Saturn Spacecraft (LACROSS), an ultra-compact plume sample collection and analysis. LACROSS will conduct these analysis *in-situ*, directly on icy samples collected from the plume during fly-throughs. Thus, LACROSS addresses five of the six Technologies solicited by subtopic S4.06.

LACROSS' sample collection & management system utilizes an innovative architecture to a) collect particles using an angled-wall collector and b) analyze them *in-situ*, without the need for sample processing and concentrating. The collector funnels ice particles into plasmonic aerogel (Stardust heritage), where particles bury and slow down to a stop. The plasmonic aerogel enables ultra-sensitive (1 nM) SERS measurements of all particles that intersect the focus plane.

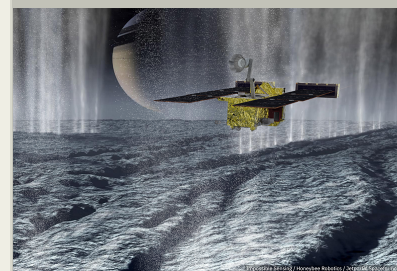
LACROSS' innovative approach to sample capture and analysis enables unprecedented in-flight sample collection and measurements of material freshly injected into space: *in-situ* chemical identification and quantitation of complex organic compounds, including pre-biotic compounds (*e.g.*, amino acids); biomolecules (organic biomarkers such as proteins, lipids, and nucleic acid polymers); minerals; salts; volatiles.

LACROSS will be a substantial technological leap with respect to existing or proposed sampling and/or analysis systems of Enceladus plume in the following key aspects: (1) it utilizes an innovative architecture to capture and transfer ice particles from plumes directly to a sensor that requires no moving parts, actuators, sample handling; (2) the multiplex integral-field SERS imaging approach features augmented science returns and reduced technical complexity relative to existing and proposed planetary Raman spectrometers; (3) LACROSS minimizes the resources and complexity required to capture and concentrate a sample *and* perform key investigations required to understand the habitability of Enceladus.

Anticipated Benefits

LACROSS improves measurement capabilities of hypervelocity particles in Ocean Worlds plumes, comet comas, and upper planetary atmospheres. It simplifies the process of sample collection and analysis with a single, streamlined instrument. LACROSS increases the sensitivity of planetary Raman spectroscopy to at least the nM range, which enables new and innovative scientific measurements that can replace complicated, risky sample collection and processing systems.

LACROSS may be adapted to measure the concentrations and concentration gradients of pollution/greenhouse gases, particularly those from the utilization of fossil fuels and aromatic volatile organic compounds *in-situ*, and in real



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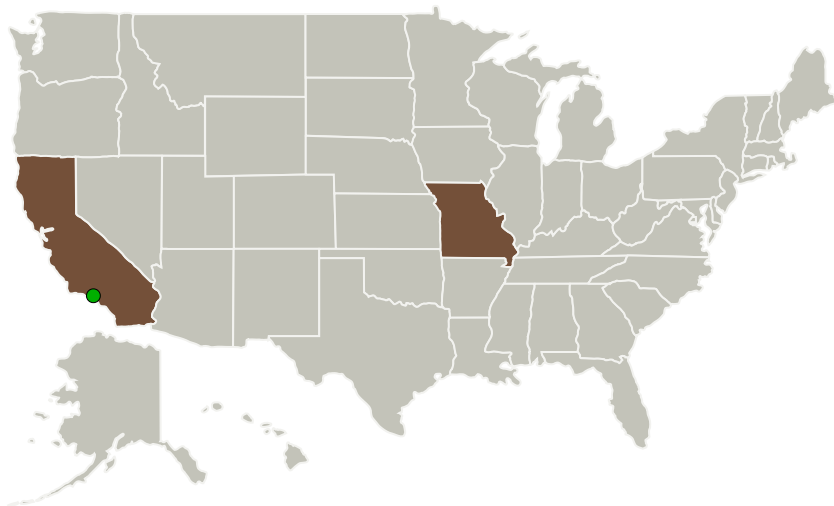
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time. LACROSS plasmonic aerogels could capture gases during atmospheric fly-throughs using unmanned aircraft (balloon, UAV) and analyze them on the fly. For example, mounted on a UAV, LACROSS can increase the efficiency of environmental monitoring.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Impossible Sensing, LLC	Lead Organization	Industry Historically Underutilized Business Zones (HUBZones)	St. Louis, Missouri
● Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations

California	Missouri
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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Impossible Sensing, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

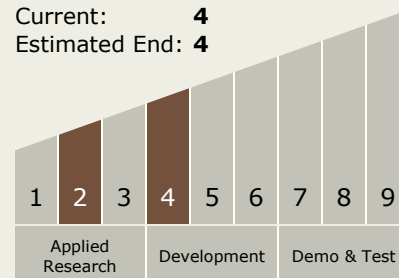
Carlos Torrez

Principal Investigator:

Pablo Sobron Sanchez

Technology Maturity (TRL)

Start: 2
Current: 4
Estimated End: 4




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Project Transitions

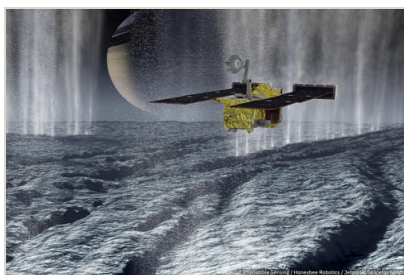
 **July 2018:** Project Start

 **February 2019:** Closed out

Closeout Documentation:

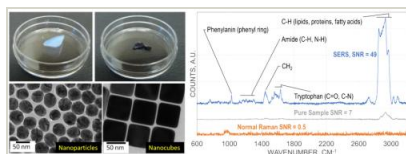
- Final Summary Chart(<https://techport.nasa.gov/file/137849>)

Images



Briefing Chart Image

LACROSS: Life Analysis, Capture, and Retention on an Orbiting Saturn Spacecraft, Phase I
(<https://techport.nasa.gov/image/133364>)



Final Summary Chart Image

LACROSS: Life Analysis, Capture, and Retention on an Orbiting Saturn Spacecraft, Phase I
(<https://techport.nasa.gov/image/126055>)

Technology Areas

Primary:

- TX08 Sensors and Instruments
 - TX08.1 Remote Sensing Instruments/Sensors
 - TX08.1.1 Detectors and Focal Planes

Target Destination

Others Inside the Solar System